

Reply to Office Action of 12/22/2005
Amendment Dated: December 28, 2005

Appl. No.: 09/975,944
Attorney Docket No.: CSCO-012 /4912

Listing of Claims

1 1 (Previously Amended): A method of processing a plurality of layer-3 datagrams in
2 a first edge router, said first edge router being connected to a second edge router by a layer-2
3 network, said method comprising:

4 provisioning in said first edge router a plurality of virtual circuits to said second edge
5 router on said layer-2 network, said plurality of virtual circuits being associated with a layer-
6 3 route;

7 receiving in said first edge router said plurality of layer-3 datagrams;

8 determining in said first edge router a subset of layer-3 datagrams, with each
9 datagram in said subset of layer-3 datagrams having a corresponding layer-3 route equal to
10 said layer-3 route, wherein said subset of layer-3 datagrams are comprised in said plurality
11 of layer-3 datagrams;

12 encapsulating each of said subset of layer-3 datagrams in a corresponding plurality
13 of layer-2 packets, all of the plurality of layer-2 packets corresponding to some of said subset
14 of layer-3 datagrams being encapsulated for sending on a first one of said plurality of virtual
15 circuits and all of the plurality of layer-2 packets corresponding to some other of said subset
16 of layer-3 datagrams being encapsulated for transmission on another one of said plurality of
17 virtual circuits; and

18 sending said plurality of layer-2 packets related to said subset of layer-3 datagrams
19 on said layer-2 network according to said encapsulating.

1 2 (Previously Amended): The method of claim 1, wherein said determining comprises
2 using a destination address comprised in each of said layer-3 datagrams to determine said
3 corresponding layer-3 route,

4 wherein said determining further determines whether to transmit each of said subset
5 of layer-3 datagrams in either said first one of said plurality of virtual circuits or said another
6 one of said plurality of virtual circuits, and

7 wherein said encapsulating comprises using a header which identifies the determined
8 virtual circuit for each layer-2 packet of the corresponding layer-3 datagram.

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1 3 (Original): The method of claim 2, wherein said layer-2 network comprises a
2 plurality of switches providing a plurality of physical paths between said first edge router
3 and said second edge router, said first one of said plurality of virtual circuits being provided
4 on a first one of said plurality of physical paths and said second one of said plurality of
5 virtual circuits being provided on a second one of said plurality of physical paths.

1 4 (Original): The method of claim 2, further comprising selecting one of said plurality
2 of virtual circuits for transmitting each of said subset of layer-3 datagrams, wherein said
3 encapsulating is performed after said selecting.

1 5 (Original): The method of claim 4, wherein said determining comprises retrieving
2 a route entry from a forwarding table using said destination address of a first IP datagram,
3 wherein said route entry indicates whether said IP route is to be used to transport said first
4 IP datagram, and wherein said selecting is performed based on said route entry.

1 6 (Original): The method of claim 5, wherein said determining is implemented in the
2 form of a process under the control of a scheduler, wherein said process and said scheduler
3 are implemented substantially in the form of software in said first edge router.

1 7 (Original): The method of claim 4, wherein said determining and selecting are
2 implemented using a data structure, which when traversed using said destination address
3 returns a layer-2 header corresponding to a virtual circuit on which a corresponding IP
4 datagram is to be sent.

1 8 (Previously Amended): The method of claim 7, wherein said determining and said
2 selecting are implemented in an interrupt handler and wherein said data structure comprises
3 a tree.

1 9 (Original): The method of claim 2, wherein layer-3 comprises Internet Protocol (IP)
2 such that layer-3 datagrams, layer-3 protocol, and layer-3 route respectively comprise IP

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3 datagrams, IP protocol, and IP route, and wherein said layer-2 comprises asynchronous
4 transfer mode (ATM) such that said layer-2 packets comprise ATM cells.

1 10 (Previously Amended): A computer readable medium carrying one or more
2 sequences of instructions for causing a first edge router to process a plurality of layer-3
3 datagrams in a first edge router, said first edge router being connected to a second edge
4 router by a layer-2 network, wherein execution of said one or more sequences of instructions
5 by one or more processors contained in said first edge router causes said one or more
6 processors to perform the action of:

7 provisioning in said first edge router a plurality of virtual circuits to said second edge
8 router on said layer-2 network, said plurality of virtual circuits being associated with a layer-
9 3 route;

10 receiving in said first edge router said plurality of layer-3 datagrams;

11 determining in said first edge router a subset of layer-3 datagrams, with each
12 datagram in said subset of layer-3 datagrams having a corresponding layer-3 route equal to
13 said layer-3 route, wherein said subset of layer-3 datagrams are comprised in said plurality
14 of layer-3 datagrams;

15 encapsulating each of said subset of layer-3 datagrams in a corresponding plurality
16 of layer-2 packets, all of the plurality of layer-2 packets corresponding to some of said subset
17 of layer-3 datagrams being encapsulated for sending on a first one of said plurality of virtual
18 circuits and all of the plurality of layer-2 packets corresponding to some other of said subset
19 of layer-3 datagrams being encapsulated for transmission on another one of said plurality of
20 virtual circuits; and

21 sending said plurality of layer-2 packets related to said subset of layer-3 datagrams
22 on said layer-2 network according to said encapsulating.

1 11 (Previously Amended): The computer readable medium of claim 10, wherein said
2 determining comprises using a destination address comprised in each of said layer-3
3 datagrams to determine said corresponding layer-3 route,

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4 wherein said determining further determines whether to transmit each of said subset
5 of layer-3 datagrams in either said first one of said plurality of virtual circuits or said another
6 one of said plurality of virtual circuits, and
7 wherein said encapsulating comprises using a header which identifies the determined
8 virtual circuit for each layer-2 packet of the corresponding layer-3 datagram.

1 12 (Original): The computer readable medium of claim 11, wherein said layer-2
2 network comprises a plurality of switches providing a plurality of physical paths between
3 said first edge router and said second edge router, said first one of said plurality of virtual
4 circuits being provided on a first one of said plurality of physical paths and said second one
5 of said plurality of virtual circuits being provided on a second one of said plurality of
6 physical paths.

1 13 (Original): The computer readable medium of claim 11, further comprising
2 selecting one of said plurality of virtual circuits for transmitting each of said subset of layer-
3 3 datagrams, wherein said encapsulating is performed after said selecting.

1 14 (Original): The computer readable medium of claim 13, wherein said determining
2 comprises retrieving a route entry from a forwarding table using said destination address of
3 a first IP datagram, wherein said route entry indicates whether said IP route is to be used to
4 transport said first IP datagram, and wherein said selecting is performed based on said route
5 entry.

1 15 (Original): The computer readable medium of claim 14, wherein said determining
2 is implemented in the form of a process under the control of a scheduler, wherein said
3 process and said scheduler are implemented substantially in the form of software in said first
4 edge router.

1 16 (Original): The computer readable medium of claim 13, wherein said determining
2 and selecting are implemented using a data structure, which when traversed using said

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3 destination address returns a layer-2 header corresponding to a virtual circuit on which a
4 corresponding IP datagram is to be sent.

1 17 (Original): The computer readable medium of claim 16, wherein said determining
2 and said selecting are implemented in an interrupt handler and wherein said data structure
3 comprises a tree.

1 18 (Previously Amended): A first edge router for processing a plurality of layer-3
2 datagrams, said first edge router being connected to a second edge router by a layer-2
3 network, said first edge router comprising:

4 means for provisioning a plurality of virtual circuits to said second edge router on
5 said layer-2 network, said plurality of virtual circuits being associated with a layer-3 route;

6 means for receiving in said first edge router said plurality of layer-3 datagrams;

7 means for determining in said first edge router a subset of layer-3 datagrams, with
8 each datagram in said subset of layer-3 datagrams having a corresponding layer-3 route
9 equal to said layer-3 route, wherein said subset of layer-3 datagrams are comprised in said
10 plurality of layer-3 datagrams;

11 means for encapsulating each of said subset of layer-3 datagrams in a corresponding
12 plurality of layer-2 packets, all of the plurality of layer-2 packets corresponding to some of
13 said subset of layer-3 datagrams being encapsulated for sending on a first one of said
14 plurality of virtual circuits and all of the plurality of layer-2 packets corresponding to some
15 other of said subset of layer-3 datagrams being encapsulated for transmission on another one
16 of said plurality of virtual circuits; and

17 means for sending said plurality of layer-2 packets related to said subset of layer-3
18 datagrams on said layer-2 network according to said encapsulating.

1 19 (Previously Amended): The first edge router of claim 18, wherein said means for
2 determining uses a destination address comprised in each of said layer-3 datagrams to
3 determine said corresponding layer-3 route,

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4 wherein said means for determining further determines whether to transmit each of
5 said subset of layer-3 datagrams in either said first one of said plurality of virtual circuits or
6 said another one of said plurality of virtual circuits, and
7 wherein said means for encapsulating uses a header which identifies the determined
8 virtual circuit for each layer-2 packet of the corresponding layer-3 datagram.

1 20 (Original): The first edge router of claim 19, further comprising means for
2 selecting one of said plurality of virtual circuits for transmitting each of said subset of layer-
3 3 datagrams.

1 21 (Original): The first edge router of claim 20, wherein said means for determining
2 retrieves a route entry from a forwarding table using said destination address of a first IP
3 datagram, wherein said route entry indicates whether said IP route is to be used to transport
4 said first IP datagram, and wherein said selecting is performed based on said route entry.

1 22 (Original): The first edge router of claim 20, wherein said means for determining
2 and said means for selecting are implemented using a data structure, which when traversed
3 using said destination address returns a layer-2 header corresponding to a virtual circuit on
4 which a corresponding IP datagram is to be sent.

1 23 (Original): A first edge router for processing a plurality of layer-3 datagrams, said
2 first edge router being connected to a second edge router by a layer-2 network, said first edge
3 router comprising:

4 a memory storing data indicating that a plurality of virtual circuits are provisioned
5 to said second edge router on said layer-2 network, said data further indicating that said
6 plurality of virtual circuits are associated with a layer-3 route;

7 an inbound interface receiving said plurality of layer-3 datagrams, wherein a subset
8 of layer-3 datagrams comprised in said plurality of layer-3 datagrams are to be transmitted
9 on said layer-3 route;

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10 a virtual circuit (VC) determination block determining to send some of said subset
11 of layer-3 datagrams on a first one of said plurality of virtual circuits and some other of said
12 subset of layer-3 datagrams on another one of said plurality of virtual circuits; and
13 an outbound interface sending each of said subset of layer-3 datagrams on a
14 determined one of said plurality of virtual circuits in the form of a plurality of layer-2
15 packets on said layer-2 network.

1 24 (Previously Amended): The first edge router of claim 23, further comprising:
2 a forwarding block determining that said subset of layer-3 datagrams are to be
3 transmitted on said layer-3 route based on a destination address contained in each of said
4 plurality of layer-3 datagrams, wherein said VC determination block determines the specific
5 virtual circuit on which to forward each of said subset of layer-3 datagrams after said
6 forwarding block determines that said subset of layer-3 datagrams are to be transmitted on
7 said layer-3 router,
8 a segmentation block segmenting each of said subset of layer-3 datagrams into a
9 plurality of payloads; and
10 an encapsulator encapsulating said plurality of payloads in a corresponding plurality
11 of layer-2 packets, wherein said plurality of layer-2 packets corresponding to each layer-3
12 datagram are encapsulated according to the determination of said VC determination block.

1 25 (Original): The first edge router of claim 24, wherein said layer-2 network
2 comprises a plurality of switches providing a plurality of physical paths between said first
3 edge router and said second edge router, said first one of said plurality of virtual circuits
4 being provided on a first one of said plurality of physical paths and said second one of said
5 plurality of virtual circuits being provided on a second one of said plurality of physical
6 paths.

1 26 (Previously Amended): The first edge router of claim 24, further comprising:
2 a forwarding table containing a plurality of route entries, wherein said forwarding
3 block retrieving a route entry from said forwarding table using said destination address of

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4 a first IP datagram, wherein said route entry indicates whether said IP route is to be used to
5 transport said first IP datagram, and wherein said VC determination block selects either said
6 first one of said plurality of virtual circuits or said another one of said plurality of virtual
7 circuits based on said route entry.

1 27 (Original): The first edge router of claim 24, further comprising a data structure,
2 which when traversed using said destination address returns a layer-2 header corresponding
3 to a virtual circuit on which a corresponding IP datagram is to be sent.

1 28 (Original): The first edge router of claim 2, wherein layer-3 comprises Internet
2 Protocol (IP) such that layer-3 datagrams, layer-3 protocol, and layer-3 route respectively
3 comprise IP datagrams, IP protocol, and IP route.

1 29 (Original): The first edge router of claim 28, wherein each of said plurality of
2 virtual circuits comprises a permanent virtual circuit (PVC).

1 30 (Original): The first edge router of claim 29, wherein datagrams related to the
2 same flow are transmitted on the same virtual circuit such that an end system need not re-
3 sequence the data in the received datagrams.